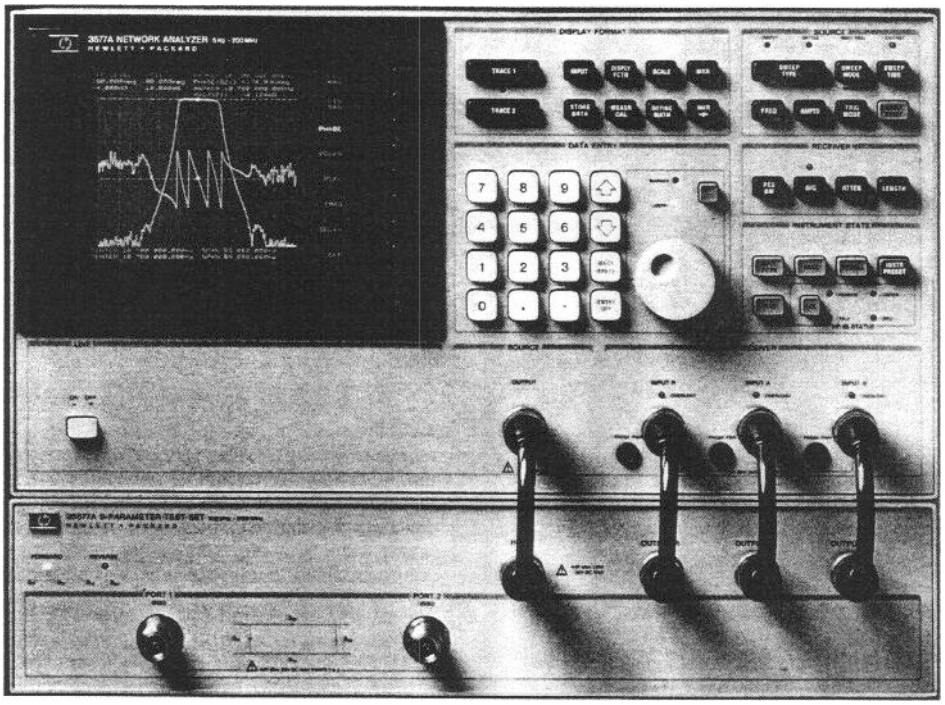
With compliments
Helmut Singer Elektronik
www.helmut-singer.de info@helmut-singer.de
fon +49 241 155 315 fax +49 241 152 066
Feldchen 16-24 D-52070 Aachen Germany

NETWORK ANALYZERS

Audio/Video/Baseband/IF Network Analyzer, 5 Hz to 200 MHz

Model HP 3577A

- High speed/high accuracy measurements
- .001 dB, .005 degree, 1 ps, .001 Hz resolution
- Built-in three-term error correction plus normalization
- Magnitude, phase, polar, real, imaginary, and group delay display modes
- Convenience features including direct plotter control and vector math functions



HP 3577A

DESIGNED FOR HP-IB SYSTEMS

Introduction

HP Model 3577A is a high performance network analyzer for audio, video, baseband and IF applications from 5Hz to 200MHz. The 3577A makes precision measurements to characterize filters, amplifiers, crystal devices, cables, and subsystems used in communications, telecommunications, consumer electronics, components and general purpose testing.

Convenient soft-key selection of measurement functions allows you to quickly measure transfer functions, magnitude/phase, insertion loss/gain, attenuation, electrical length and gain compression. In addition, measurement of phase distortion parameters such as group delay and deviation from linear phase can be made with high resolution. With the HP 3577A's flexible receiver input impedances, you can measure in either 50-Ω or high impedance (1 MΩ) environments. Use the HP 35677A/B S-Parameter Test Sets or the HP 35676A/B Reflection/Transmission Test Kits with the HP 3577A to make reflection measurements such as return loss, reflection coefficient and impedance in 50-Ω or 75-Ω systems, while simultaneously displaying transmission parameters.

With the addition of an HP 9000 Series 200 or 300 Computer and appropriate system software, the HP 3577A becomes the hub of a powerful network measurement solution, the HP 3577S Network Analyzer System. A full description of the HP 3577S begins on page 616.

Unprecedented Measurement Precision

Precision measurements can be made to characterize both wideband and narrowband devices with high accuracy and resolution. Dynamic magnitude and phase accuracy is 0.02 dB and 0.2 deg, respectively. Device responses can be examined in fine detail with 0.001 dB, 0.005 deg, and 1 ps resolution. A built-in synthesized LO and tracking generator assure superb frequency accuracy with 0.001 Hz resolution. Dynamic range is 100 dB and the noise floor is −130 dBm for the most demanding measurements.

Versatility and Convenience

User-defined Vector Math functions operate on measured data, constants and functions to present measurement results in the form you need. Multiple Display Formats with electronic graticules provide accurate display in rectangular, polar or Smith chart coordinates. Frequency Sweep (Logarithmic, Linear or Alternate) and Amplitude Sweep capabilities meet measurement needs in a wide range of applications. Accessories such as S-Parameter Test Sets, Power Splitters, Minimum Loss Pad, Cables, Calibration Kits, Transistor Fixtures, Adapters, and Current and Voltage Probes ensure a complete solution to your measurement needs.

The built-in autoscale functions put the measurement on the screen quickly with a full scale display. Digital Display Markers with Marker → Min or Max and Marker Offset capabilities provide accurate, high resolution readout of data points on a fully annotated dual trace display. Direct Digital Plot (using an HP graphics plotter without a computer) of displayed traces, graticule, annotation and marker data provides quick, cost-effective hard copy of measurement results. Nonvolatile Save/Recall Memory of five front panel instrument states is convenient for making rapid and repeatable measurements.

Similarly, trace data can be stored in magnitude and phase format in any one of four data registers. Since data is stored with full accuracy and resolution, it can be rescaled as needed.

Measurement Display Modes

Magnitude, phase, polar, real, imaginary, and delay modes are directly accessible from the soft key display menu. Input data, stored data and user-defined constants can then be combined using built-in vector math functions (+,−,*,/) to create arbitrary measurement display modes. As an example, a feedback amplifier can be mathematically analyzed by measuring its open loop gain, storing the data, and then adjusting a complex variable which represents the amount of feedback in the closed-loop gain equation.

High-Performance Group Delay Measurements

The HP 3577A measures group delay directly by dividing the measured phase changes across a selected frequency aperture by the aperture value. The frequency aperture can be set from 0.5% to 16% of span with annotation directly in Hertz, thus allowing the user to change span and still retain the same effective smoothing.

Sophisticated measurements of both magnitude and phase distortion in communication systems can be made.

Cables and transmission lines can be tested for maximally flat delay with a resolution of up to 1 psec.

Vector Noise Averaging

Noise reduction in the HP 3577A is accomplished by Vector Noise Averaging and/or selectable Resolution Bandwidth filters. With the proper use of these two noise reduction methods, greater than 130 dB dynamic range can typically be achieved.

Built-in Error Correction

Three-term Vector Error Correction in the HP 3577A is used to remove the effects of directivity, frequency response, and source mismatch from one-port measurements. Similarly, vector normalization enhances the accuracy of two-port measurements at the push of a button. These powerful accuracy enhancement routines can be used to cancel the repeatable error introduced by cable and test fixtures. Moreover, the HP 3577A can be easily upgraded to an HP 3577S Network Analyzer System with full twelve-term Vector Error Correction, as the need for uncompromising measurement accuracy arises.

HP-IB Programmability

The HP 3577A is fully programmable over the Hewlett-Packard Interface Bus. Simple programming codes minimize the time it takes to develop control software for automatic measurements. Quickly access a single point or an entire 401-point trace in either fast binary or ASCII modes. Customize the built-in vector display via the HP-IB to draw test limit lines, operator instructions or connection diagrams.

HP 3577A Network Analyzer Abbreviated Specifications

Source

Frequency

Range: 5 Hz to 200 MHz
Resolution: 0.001 Hz
Stability: $\pm 5 \times 10^{-8}$/day, 0 to 55°C

Amplitude

Range: +15 dBm to −49 dBm (1.26Vrms to 793μ Vrms: 2dBV to −62 dBV) into a 50Ω load
Resolution: 0.1 dB
Accuracy: ±1 dB at + 15 dbm and 100 kHz. Below + 15 dBm, add the greater of ±0.02 dB/dB or 0.2 dB
Flatness: 1.5 dBp-p from 5 Hz to 200 MHz

Impedance: 50Ω; >20 dB return loss at all levels
RF Output Connector: 50Ω Type N female
Sweep Types: Linear, alternate, cw and log frequency; log amplitude
Sweep Time: 100 ms/span to 200 ms/span for frequency sweep; 1 ms/step to 16 s/step for amplitude sweep.
Sweep Modes: Continuous, single, manual
Trigger Modes: Free run, immediate, line, external

Input Characteristics

Frequency Range: 5 Hz to 200 MHz
Inputs: Three receiver inputs (A, B and R)
Input Impedance: Selectable 50Ω with > 25 dB return loss, or 1 MΩ in parallel with approximately 30 pF
Input Connectors: 50Ω Type N female
Full Scale Input Level: −13 dBV from 10 kHz to 200 MHz with internal 20 dB attenuators ON (0dBm at 50Ω)
Resolution Bandwidth: Selectable 1 kHz, 100 Hz, 10 Hz, or 1 Hz
Sensitivity (Due to noise and internal crosstalk between source and receiver inputs):

Resolution Bandwidth	30 kHz - 200 MHz (50Ω) 30 kHz - 20 MHz (1 MΩ) Internal 20 dB Attenuator ON	Internal 20 dB Attenuator OFF
1 Hz	-110 dBm	-130 dBm
10 Hz	-110 dBm	-130 dBm
100 Hz	-105 dBm	-125 dBm
1 kHz	-95 dBm	-115 dBm

Crosstalk: >100 dB isolation between inputs.
Electrical Length/Reference Plane Extension: Provides equivalent electrical line length, or delay at inputs A, B and R. Range: -3×10^8m to $+3 \times 10^8$m or +1 s to −1 s
Resolution: 5 digits or 0.1 cm (3.3 ps) whichever is greater
Accuracy: ±0.1 cm or ±0.02% whichever is greater.

NETWORK ANALYZERS

Audio/Video/Baseband/IF Network Analyzer, 5 Hz to 200 MHz

HP Model 3577A (cont.)

Magnitude Characteristics

Range: Full Scale Input to Sensitivity

Resolution

Marker: 0.001 dB (log); 5 digits (linear)

Display: 0.01 dB/div to 20 dB/div (log absolute); 0.01 dB/div to 200 dB/div (log ratio); 0.1 nV/div to 10 V/div (linear absolute); 10^{-10}/div to 10^{20}/div (linear ratio)

Display Units: dB, dBm, dBV, V, and linear ratio.

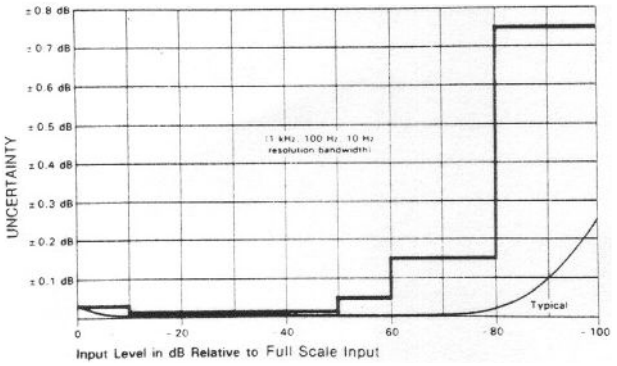
Accuracy (at 100 kHz, 25°C, and Full Scale Input)

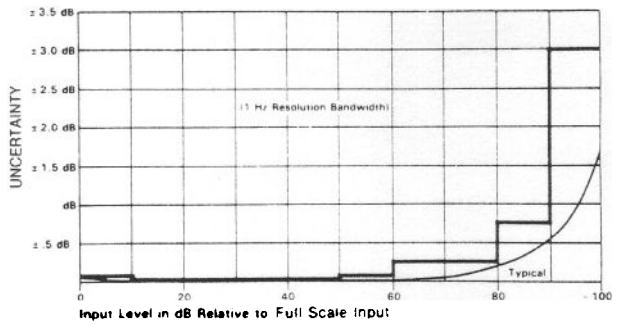
Absolute (A, B, R): ±0.2 dB

Ratio (A/R, B/R, A/B): ±0.15 dB (50Ω); ±0.2 dB (1 MΩ).

Dynamic Accuracy:

Error		Input Level Relative to Full Scale Input
Resolution Bandwidth		
1 kHz, 100 Hz, 10 Hz	1 Hz	
±.04 dB	±.04 dB	0 dB to −10 dB
±.02 dB	±.02 dB	−10 dB to −50 dB
±.05 dB	±.05 dB	−50 dB to −60 dB
±.15 dB	±.25 dB	−60 dB to −80 dB
±.75 dB	±.75 dB	−80 dB to −90 dB
±.75 dB	±3.00 dB	−90 dB to −100 dB





Frequency Response (when driven from a 50Ω source and with 50Ω receiver input impedance)

Absolute (A,B,R): 0.3 dBpp from 20 Hz to 20 MHz; 0.6 dBpp from 5 Hz to 200 MHz

Ratio (A/R, B/R, A/B): 0.3 dBpp from 20 Hz to 20 MHz; 0.4 dB from 5 Hz to 200 MHz

Reference Level

Range: −207 dBm to +33 dBm (−220 dBV to +20 dBV) (Log absolute); −400 dB to +400 dB (log ratio); 0 V to 10 V (linear absolute); 0 to 10^{20} (linear ratio)

Resolution: 0.001 dB (log); 5 digits (linear)

Stability

Temperature: Typically < ±0.02 dB/°C

Time: Typically < ±0.05 dB/hour at 25°C

Phase Characteristics (A/R, B/R, A/B)

Range ±180 deg.

Resolution

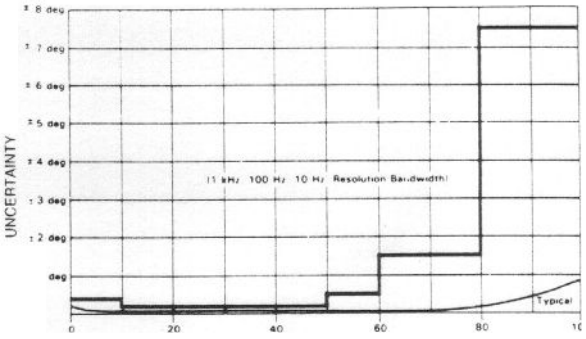
Marker: 0.005 deg (0.001 rad)

Display: 0.01 deg/div to 200 deg/div (0.00018 rad/div to 3.49 rad/div)

Accuracy (at 100 kHz, 25°C, and Full Scale Input: ±2.0°

Dynamic Accuracy:

Error	Input Level Relative to Full Scale Input
±.4 deg	0 dB to −10 dB
±.2 deg	−10 dB to −50 dB
±.5 deg	−50 dB to −60 dB
±1.5 deg	−60 dB to −80 dB
±7.5 deg	−80 dB to −100 dB



Reference Level Resolution: 0.01 deg.

Temperature Stability: Typically < ±0.05 deg/°C.

Time Stability: Typically < ±0.05 deg/hr at 25°C

Delay Characteristics

Range: 1ps to 20.000s

Resoultion: .01ns/div to 1000s/div

Normalized Accuracy: $\frac{\text{Dynamic Phase Accuracy}}{360 \times \text{Aperture [Hz]}} + 2\text{nS}$

Aperture Range: 0.5% to 16% of frequency span.

Reference Level: ± 10^3S

General Display Characteristics

Traces

No. Traces: Two simultaneous traces may be present with a rectangular graticule. One trace with polar or Smith graticules.

Markers: Each trace has one main marker and an offset marker. Markers indicate data at corresponding trace coordinates in the same units as used to set the Reference Level. Markers can be used to modify certain display parameters. Marker resolution is the same as horizontal display resolution.

Graticules

Rectangular Graticule: 0% to 100% full scale deflection in 0.05% increments. Logrithmic and Linear.

Polar/Smith Chart Graticule: ±500 deg in 0.001 deg increments.

Noise Averaging

Type: Exponentially weighted vector averaging on successive sweep data.

Averaging Factor: Selectable 1 (off), 4, 8, 16, 32, 64, 128, 256.

Linear Phase Slope Compensation: Provides linear phase slope offset of −72,000 deg/span to +72,000 deg/span.

Calibration

Transmission: Both traces can be normalized to measured data with full accuracy and resolution.

Reflection: Corrects for directivity, frequency response and source match errors.

Programming Characteristics

Capability: Remote programming via the Hewlett-Packard Interface Bus (HP-IB). The HP 35677A/B S-Parameter Test Sets are programmable through the HP 3577A interface only.

Interface Functions: SH1, AH1, T5, TE0, L4, LE0, SR1, RL1, PP1, DC1, DT1, C0, E1. For more on these codes refer to the HP-IB section of this catalog.

Output Data Transfer Time: 401 data points (single parameter) can be transferred directly to an HP 200 series computer in Basic language as follows:

ASCII mode: Typically 1500 ms.
Binary-floating point mode: Typically 160 ms.

Graphics Capabilities: 12 lines of text with 40 alphanumeric characters per line, and high resolution line vectors can be displayed through HP-IB commands.

General Characteristics

External Reference Frequency Input

Frequency: 10 MHz/N. N is an integer from 1 to 100.
Level: 0 dBm ±10 dB, nominal.
Impedance: 50Ω, nominal.
Connector: BNC female, rear panel.

Reference Frequency Output

Frequency: 10 MHz.
Level: Typically 0 dBm.
Impedance: 50Ω, nominal.
Connector: BNC female, rear panel.

External Trigger: Triggers on negative TTL transition or contact closure to ground.
Connector: BNC female, rear panel.

Plotter Control: Directly compatible with HP-IB graphics plotters that use Hewlett-Packard Graphics Language (HP-GL) with listen only capability: HP 7470A, HP 7475A, HP 7550A, HP 7090A.

Save/Recall: Front-panel setups can be stored in non-volatile memory locations 1 through 5. Last state is saved when power is removed.

Operating Conditions

Temperature: 0°C to +55°C.
Relative Humidity: <95% at 40°C.
Altitude: <4,572m (15,000 ft).

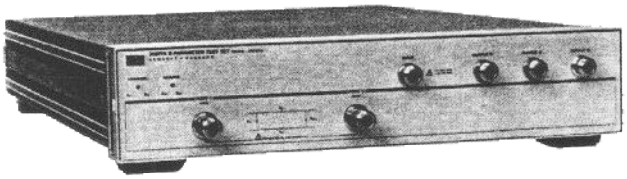
Non-Operating Conditions

Temperature: −40°C to +75°C.
Altitude: <15,240m (50,000 ft).

Power: 115V + 10%, −25% (47 Hz to 440 Hz), or 230 V + 10%, −15% (47 Hz to 66Hz), 450 VA maximum.

Weight: 31 kg (67 lb) net; 41 kg (90 lb) shipping.

Dimensions: 222 mm H x 426 mm W x 578 mm D (8.75 in. x 16.75 in. x 22.75 in.).



HP 35677A/B S-Parameter Test Sets

While test setups can be constructed from discrete RF components such as power dividers, directional bridges, cables, pads, etc., it is much easier to use a fully integrated test set such as the HP Model 35677A/B.

The test set contains the hardware required to make transmission and reflection measurements in both the forward and reverse directions. The only setup required is to connect the device under test to the two measurement ports; the HP 3577A Network Analyzer controls the switching functions, so that even reverse measurements can be made without changing device connections. The HP 35677A is used for 50Ω systems and the HP 35677B is used for 75Ω systems.

HP 35677A/B S-Parameter Test Set Specifications

Frequency Range: 100 kHz to 200 MHz.

Test Port Impedance

HP 35677A: 50Ω.
HP 35677B: 75Ω.

Directivity: >40 dB.

Frequency Response

Transmission (S_{21}, S_{12}): ±1 dB, ±5 degrees.
Reflection (S_{11}, S_{22}): ±1 dB, ±5 degrees.

Port Match

Test Ports 1, 2: HP 35677A, >26 dB; HP 35677B, >24 dB.
Test Ports 1, 2 Open/Short Ratio: HP 35677A, <±0.75 dB magnitude and <±5 degrees phase; HP 35677B, <±1 dB magnitude and <±7.5 degrees phase.
Input Port: >20 dB return loss.
Output Ports A, B, and R: >26 dB return loss.

Test Port Isolation: >100 dB.

Insertion Loss

RF Input to Test port 1 or 2: HP 35677A, typically 13 dB; HP 35677B, typically 19 dB.
RF Input to Output Ports A, B, or R: HP 35677A, typically 19 DB; HP 35677B, typically 31 dB.

Test Port Reciprocity

Transmission (S_{21}, S_{22}): Typically <±0.5 dB magnitude and <±5 degrees phase.
Reflection (S_{11}, S_{22}): Typically <±0.5 dB magnitude and <±5 degrees phase.
Incident Power Ratio (Test Port 1 to Test Port 2): Typically <±1.5 dB.

RF Input Maximum Operating Level: +25 dBm or ±30 Vdc.
RF Input Damage Level: ±27 dBm or ±30 Vdc.
Port 1 or 2 Damage Level: +27 dBm or ±30 Vdc.

Connectors

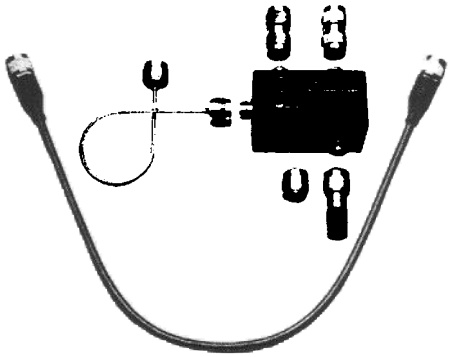
Input Port and Output Ports A,B, and R: 50Ω Type N female.
Test Ports 1 and 2: HP 35677A, 50Ω Type N female; HP 35677B, 75Ω Type N female.
DC Bias Inputs: BNC female, rear panel.
DC Bias Range: Typically ±30 Vdc and ±20 mA with some degradation of RF specifications; 200 mA damage level.

Accessories Supplied

4 ea. 190 mm (7.5 in.) 50Ω cables with Type N male connectors for connection to HP 3577A (HP Part No. 8120-4387).
1 ea. Test Set interconnect cable to HP 3577A (HP Part No. 35677-61620).
1 ea. Rear Panel Lock Foot Kit (HP Part No. 5061-0099).
1 ea. Service Manual (HP Part No. 35677-90010).

General Characteristics

Power: All power is obtained through the HP 35677A interconnect cable.
Weight: 6 kg (13 lb) net; 122 kg (25 lb) shipping.
Dimensions: 90mm H x 425mm W x 584mm D (3.5 in. x 16.75 in. x 22.75 in.). Add 1⅛ inch to depth to include front panel connectors.



HP 35676A/B Reflection/Transmission Test Kits

Low frequency and broadband measurements with the HP 3577A are greatly simplified with the HP 35676A/B Reflection/Transmission Test Kits. Operating in conjunction with internal calibration routines in the HP 3577A, the test kits provide all the measurement capabilities required for reflection, transmission, and impedance measurements throughout the entire 5 Hz to 200 MHz frequency range. Separate versions are available for 50Ω (HP 35676A) or 75Ω (HP 35676B) environments. Each HP 35676A/B Reflection/Transmission Test Kit contains a precision resistive divider, 50Ω (HP 35676A) or 75Ω (HP 35676B) reference load, coaxial short, carrying case, and all cables and hardware necessary for basic measurements with the HP 3577A Network Analyzer.

HP 35676A/B Operating Characteristics*

Freq. Range: 5Hz to 200 MHz
Test Port Impedance: 50 ± 2% typical (HP 35676A)
75 ± 2% typical (HP 35676B)

Insertion Loss (Source Input to Test Output): 10 ± 1 dB typical
Equivalent Directivity: 40 dB typical.
Equivalent Source Match: 30 dB typical (HP 35676A)
25 dB typical (HP 35676B).

Ordering Information

See page 617 for Ordering Information.

*Typical, assuming proper calibration with accessories supplied.